assembly of architecture of assembly

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Donaldson

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Blacksburg, Virginia

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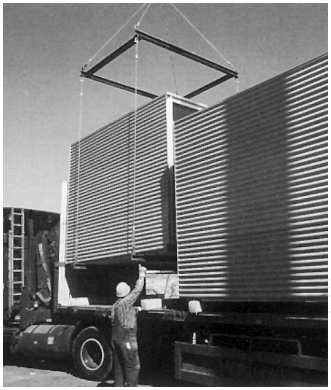
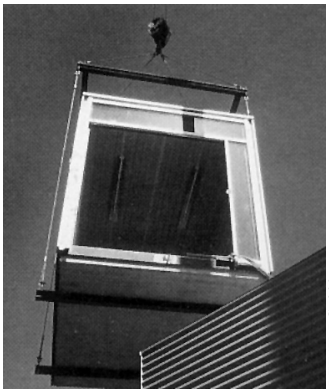
Abstract

The thesis project was the vehicle for an investigation of prefabrication, assembly, and the design of a lived space. Elements are separated from the building and from each other. This separation is both physically and functionally significant. This separation of elements is presented as the architecture of a joint. The wall is divided into two parts: exterior and interior; creating a wall that is analogous to a double wall system. The exterior wall is the weather barrier, while the interior wall houses the functional necessities for a building, and the extremities of lived spaces. The gap, or joint, is exploited for its ability to be a transportation system. The joint is both vertical and horizontal, separating inside from outside and one unit from the other. The clarity of elements and the method of construction articulates the joint. A well designed element is fabricated and brought to the site. Its independence in construction is a metaphor for the element's ability to stand alone with its architecture, and when assembled underlines the strengths of the unit. The unit presented is one investigation of the varying possibilities of assembly.

Selecting a Method of Construction



DETAIL PG. 809



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What are the construction methods available to an architect? Houses are different than skyscrapers. Bowling alleys are different from greenhouses. Are their methods of construction different? There are two popular methods for building any object or structure: build on-site or build off-site. Each method sculpts raw materials into a finished product but in each case the completed product will differ in character.

The architecture of building on site is the direct development of raw materials brought to the construction site and formed locally into the finished product. There is a coherent quality to this construction. Pieces are 'cut to fit' and the craft of the building is dependent upon the craftsmanship of the builders. Design decisions may also be made by the workers constructing the building.

The thesis project must be manufactured with extreme care and precision. If the thesis was constructed by hand, the quality of the finished product would never satisfy the architect. The elements are manufactured in a way that allows their assembly to be flexible in organization but not flexible in form or material. The on-site method of construction is found in the majority of construction sites, however, in this thesis it is kept to a minimum.

Building off-site differs from on-site construction in that elements have previously been designed, and during the construction only assembly is necessary. An entity can contain everything necessary to be considered a 'complete' object. The examples presented in this document are entities that arrive 'complete' to the construction site.

None of these fabricated entities are ultimately 'complete' until set into the context. This is very important to the success of the design. The fabricated entities are now measured against the context in which they are placed.

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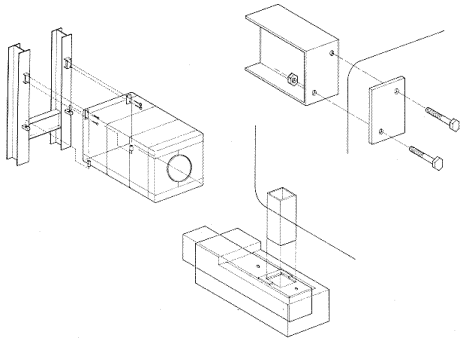
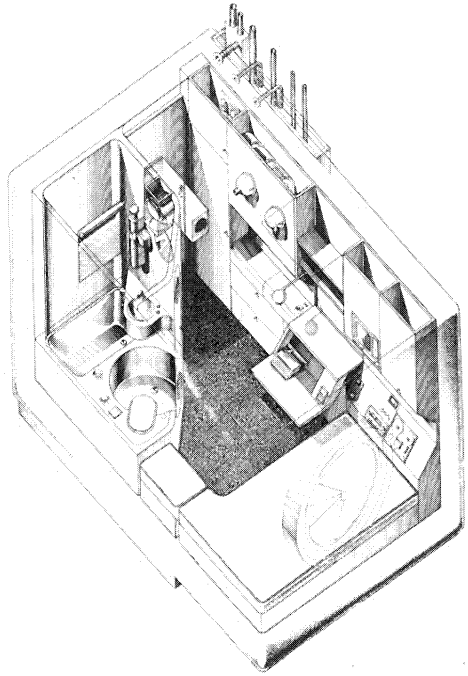
DAI-ICHI
HOTEL



KISHO PG. 108



KISHO PG. 109

The 'complete' fabricated unit has little flexibility in its organization. The arrangement of 'complete' units can be of different configurations in the site, but each unit lends itself to look like the others. This lack of flexibility in the unit is what deterred the architect from choosing this method of construction for this thesis.

The assembly of parts is another method of construction. Buildings can be designed as a 'kit of parts' and assembled on site. This design method is more difficult because every aspect of building has to be taken into consideration during the design phase. This becomes especially hazardous because a discovery during construction has the potential to alter the entire project. The primary aspect of this architecture is the element designed with an interchangeable proportional module, creating multiple possibilities in the assembly of similar elements.

Both methods have advantages and disadvantages. The architectural question is: which construction method is more appropriate for a particular project? The thesis project's scope is a dwelling for a single individual. This unit is able to be mass produced and placed into many sites around the world. The selection of using a prefabricated method of construction for high density housing is a valid architectural decision. Using this technique allows the architect to design elements which are of high quality; economically built with confidence that the finished product is precise, well crafted, and effective.

Identical elements may be assembled in a different configuration to create varying solutions to a common question. This possibility of arrangement makes the thesis project slightly different from a typical 'kit of parts.' Generally there is only one correct way to assemble a kit.

The design presented is just one of many possibilities for the arrangement of elements. This flexibility ensures the project's assembly in different sites with similar success.

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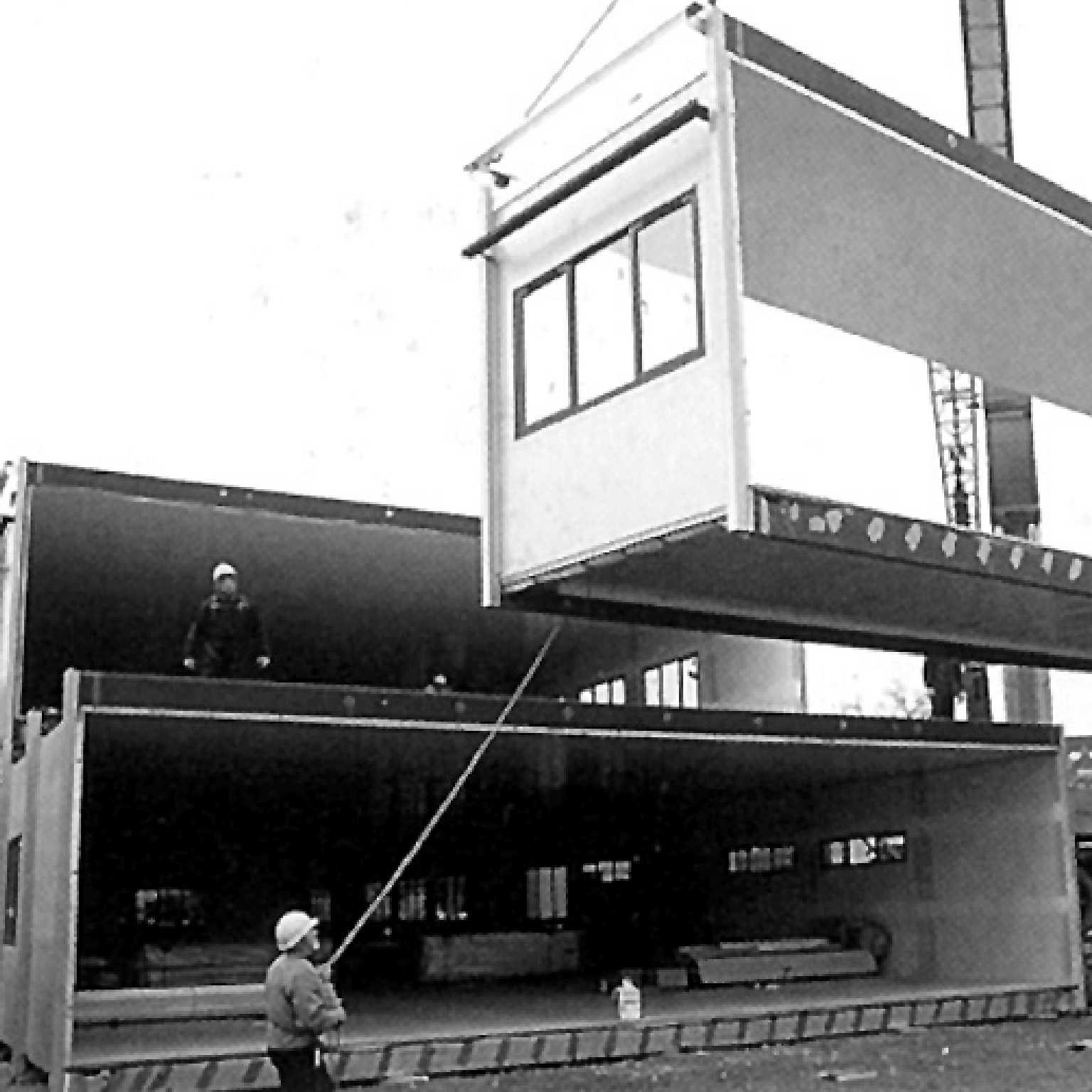

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The elements themselves take on a complexity which is greater than standard construction. This is acceptable because architecture demands confidence from form and material. To change the material of a element would not change its role in the architecture, but the form which the element manifests.

Construction is the moment that architecture becomes tangible. The method of construction will reflect the quality of the finished product. Elements set into place by a crane are different from elements handled by a person. Crane-placed objects are heavy and large in scale. Their tactile quality also reflects their scale of construction. The other pieces assembled by hand are more receptive to the scale of the human body. A team of workers may install the interior panels without the aid of large construction equipment.

This project is not just a well designed piece of architecture, but a tool for the discovery of architectural thoughts, leading to a clarity of different construction methods, and the architecture of assembly.

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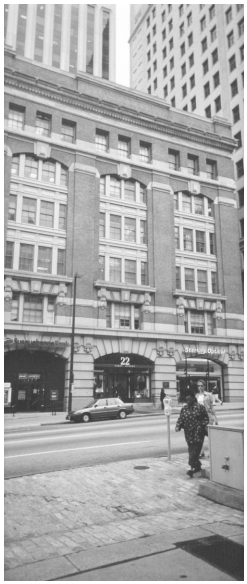
The Architecture of Site


SIGNS


FOR SALE
SIGNS BY TOMORROW


BY TOMORROW


FOR SALE
SIGNS BY TOMORROW



What is a building site? "Site" is more than a location for a building; it is a collection of architectural parameters which cannot be anticipated by the architect. The site conditions should be a positive influence on the design rather than an obstacle.

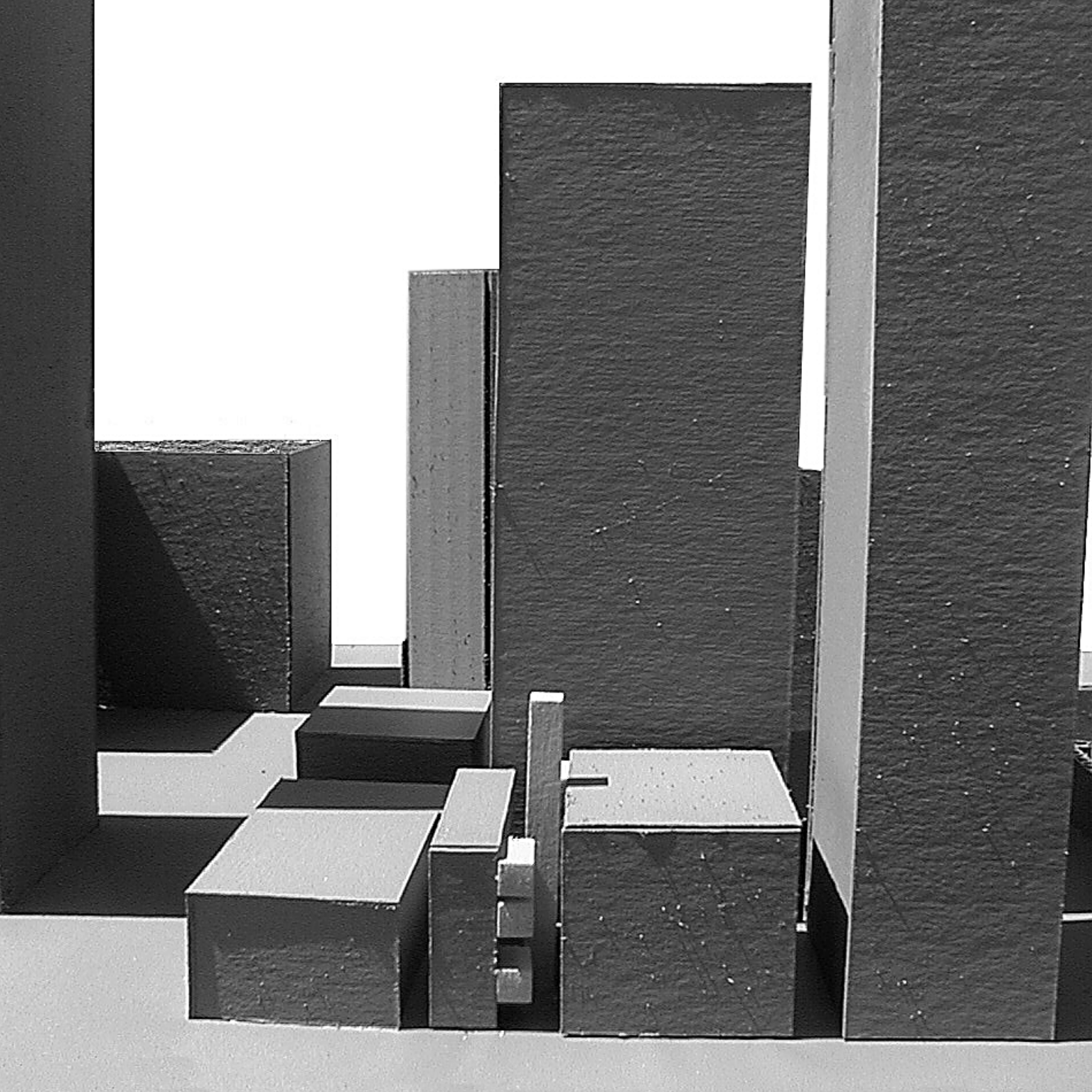
What are the consequences of an urban setting? The city is Baltimore, Maryland, and the site is very rigorous. It is a vertical slot 24 feet in width; making this restriction the most influential quality of this site. How many persons can occupy this site comfortably? What activities are appropriate for a 24 foot wide site? Is it necessary to use all of the site for building?

The perimeter of the site is defined by two edges of existing brick buildings. The other edges are opened, while one side opens towards the street and the other opens towards an alley. The alley view focuses on an existing office building. These are physical and visual boundaries.

The life of the city itself is the other parameter of the site. Cities are generally crowded and filled with many types of pollution; Baltimore is no exception. The panels on the unit are the barrier from the air and noise pollution of the city.

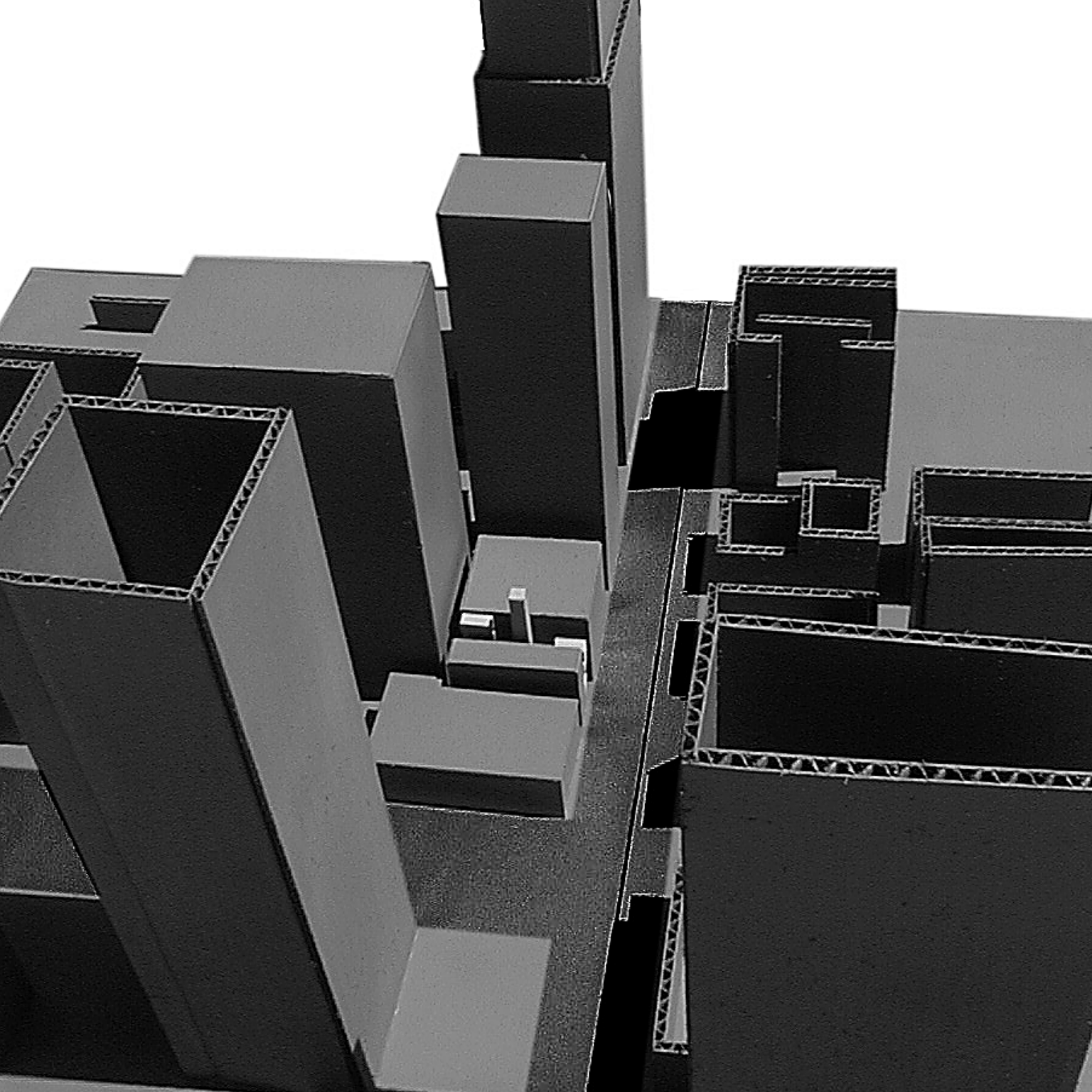
'Site' is the surrounding physical environment, the activities associated with that environment, and the program of the project. Program is an established condition outside of the architect's desire for building. Before an architect can begin any project of any size the program has a presence in the design. The program may be as abstract as the definition of building type, or it may be as specific as a list of finish materials. In this thesis the definition of program is the building type and how it is constructed.

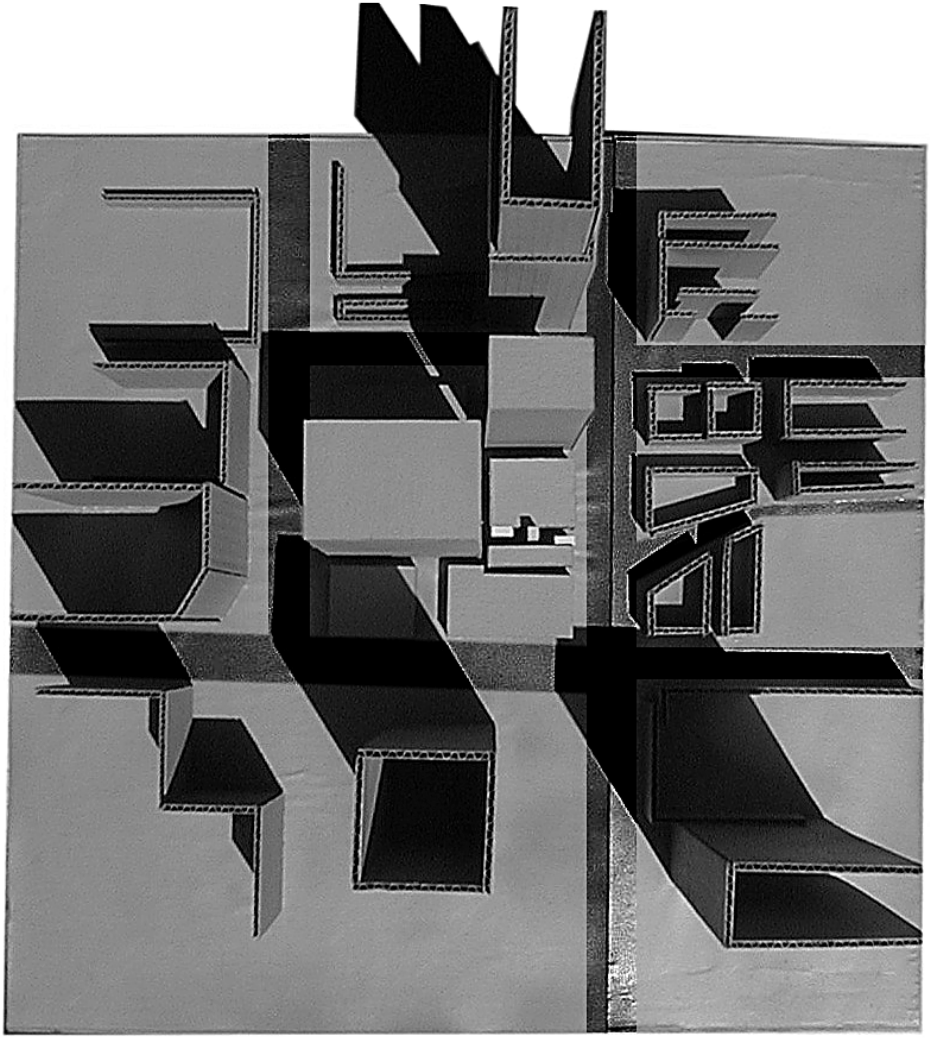
The building type is a single person dwelling, but it functions as an apartment complex. The tenants have single units which are clustered into the site. Each unit contains the facilities for living.



The architect did set a limit to the number of furnishings designed. This limit allows the tenants to bring their own possessions to the apartment, mainly the sofa/bed. The architect cannot control the action of the tenant, but he strongly influences the placement of the sofa/bed.

The construction method is also part of the program as it was anticipated before the start of the design. The assembly of elements is more advanced than the usual 'kit of parts.' The construction method did not govern the thesis; it provided a beginning for asking questions about how to design the thesis.



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CURRENT STREAK IS
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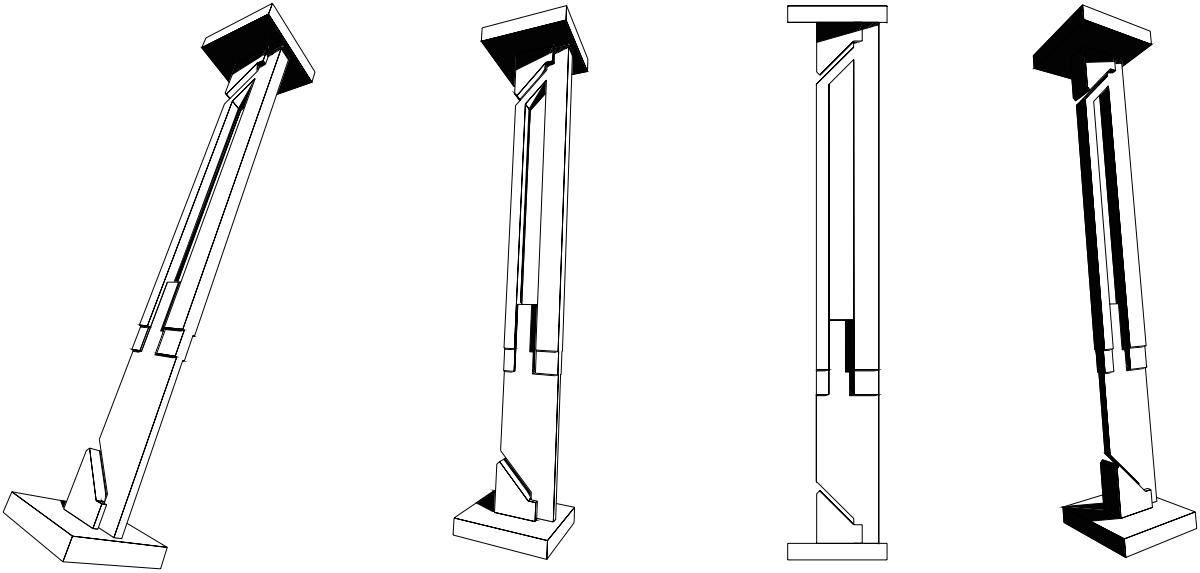
FOR SALE
BUILDING - 410-666-1372

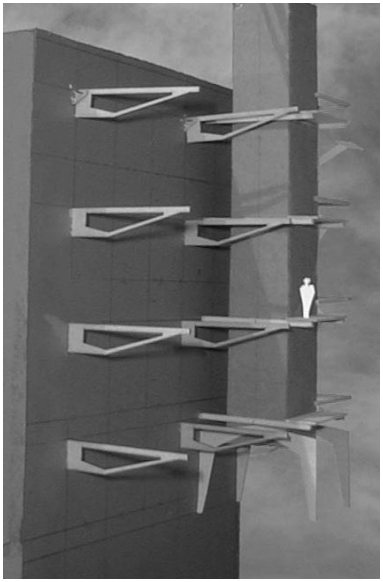
The Frame



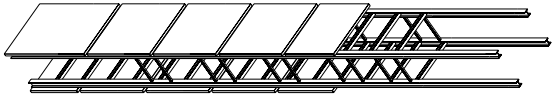
The beam is the frame. It is site specific because the beam bridges between two existing buildings. The unit rests atop the beam and the load is transferred to the walls of the two existing buildings. The bearing connection is articulated with a site cast concrete element. This element is cast into the exiting wall, tying into the existing structure. The precast beams are then placed into this cradling element. The bearing connector is one of the elements which has to be constructed with an on-site method of construction.

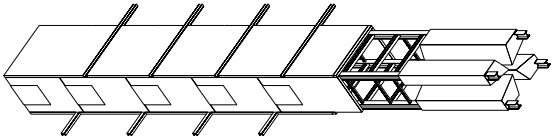
The beam contains an opening allowing utility functions to pass through it to the unit. This opening is present in the earliest of design models. A horizontal site may eliminate the elevator, but the beam would remain. The beam or frame may take on another form, for example a wall, concrete grid, or structural tower. The frame is always present in the project because it is the mediator between site and unit. This beam depends on this site for its success in the design.

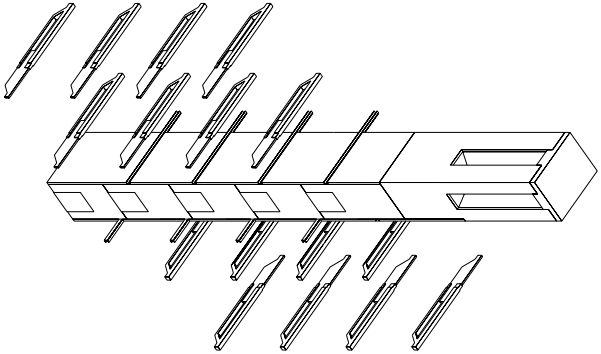
The solid portion of the beam transitions into the opening. This transition is an articulated moment between opened and closed. This creates a complexity within the form of the beam without making the beam a complex entity. The complexity is achieved through simple changes in the thickness of the concrete. The end of the beam beneath the unit, the opening, is thicker in section than the solid end of the beam. The transition between thick and thin is articulated with the stepping of the concrete.



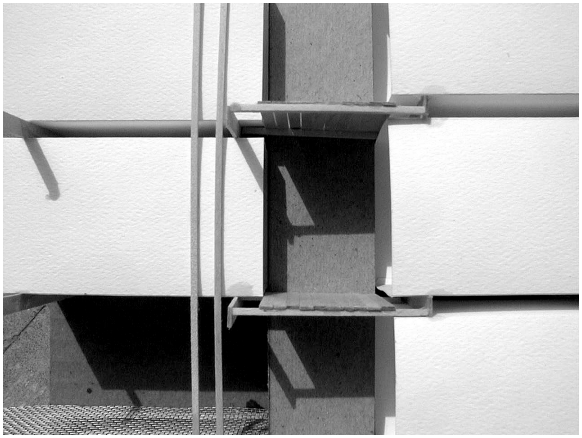
Elements of Assembly

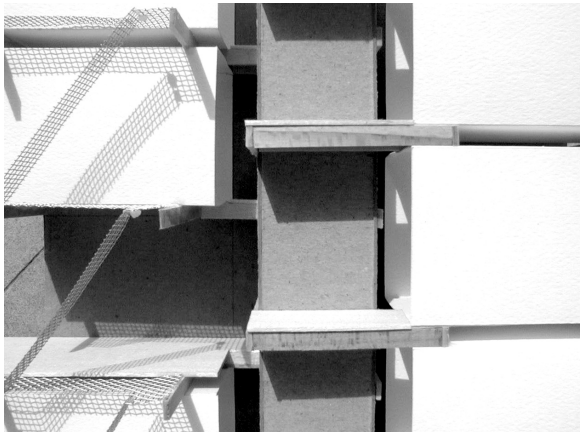


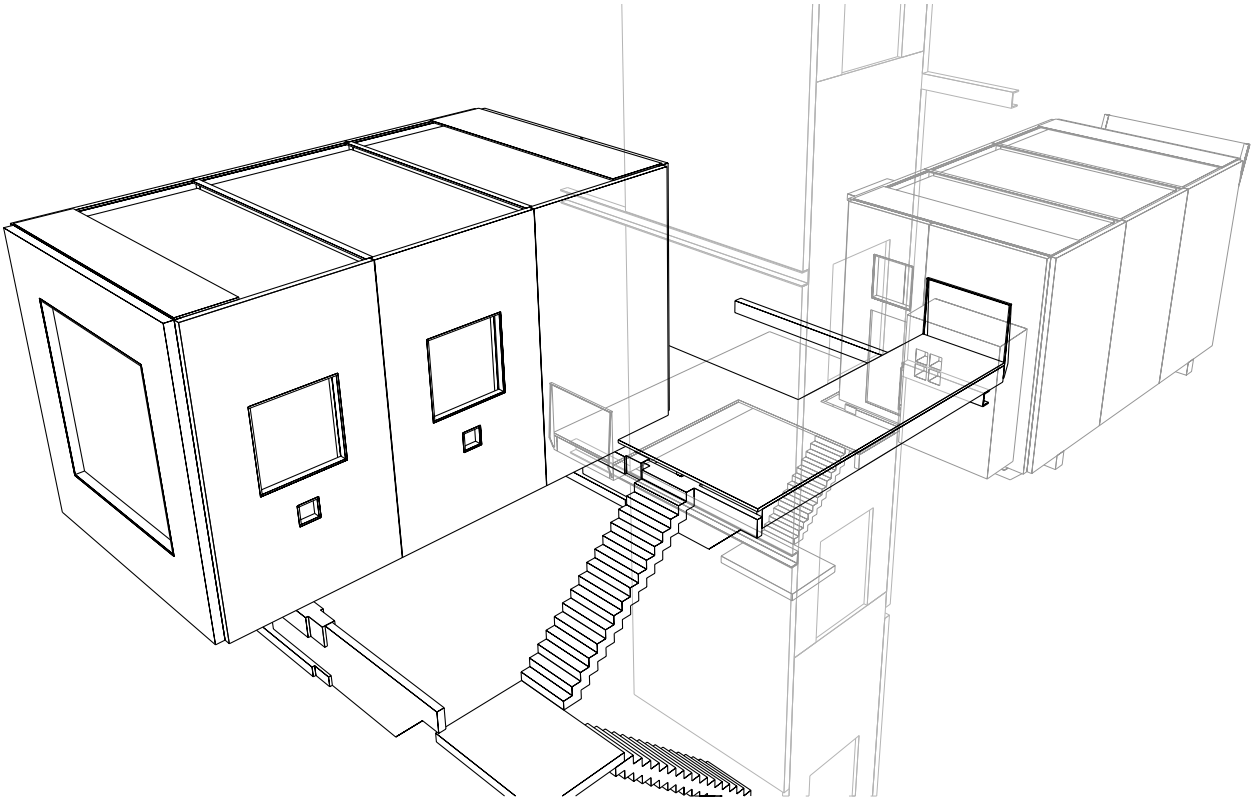


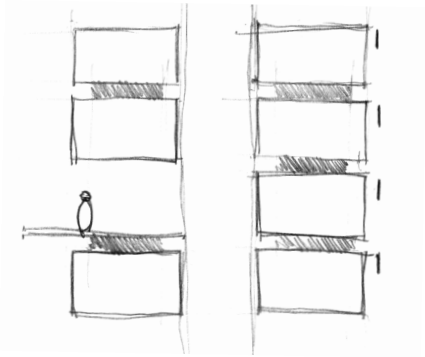


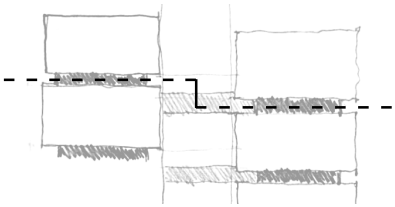
The Architecture of Juxtaposition

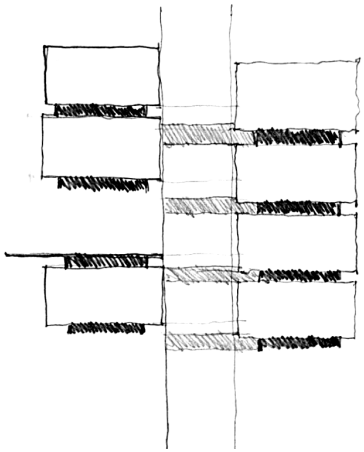












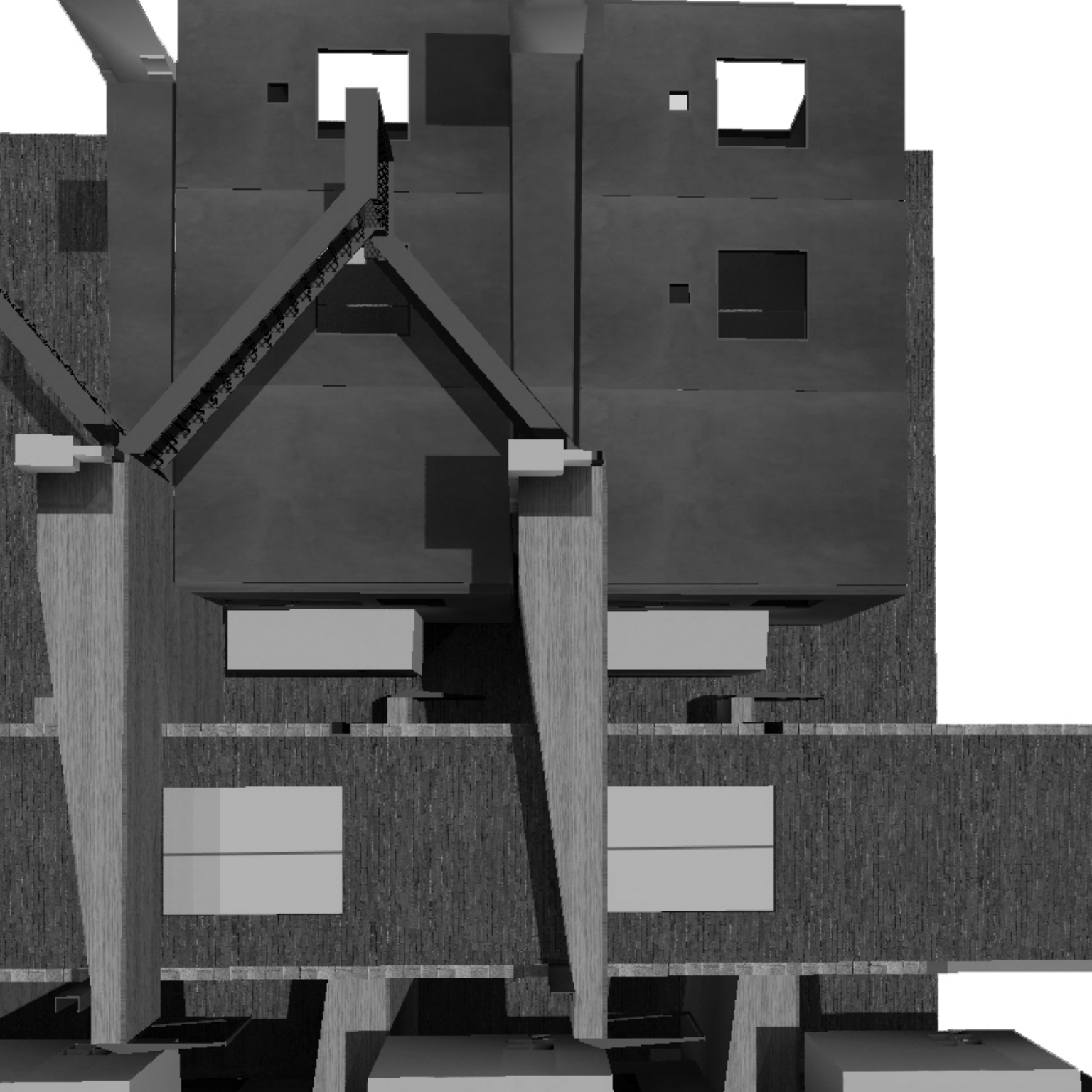
What is the architecture of two or more things placed next to each other? The units have two qualities when set into the site. The first is the juxtaposition of the front three relative to the back four, and the other is the juxtaposition of two units, one above the other.

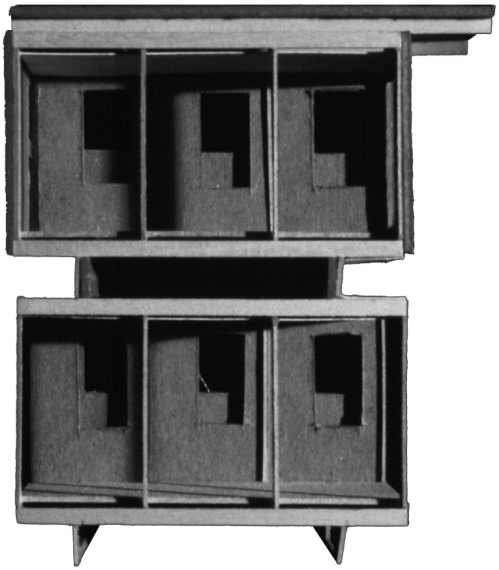
The sketch to the left shows the original arrangement of units. The front three were positioned in the site at the same height as the back four. The sketch at the bottom of this page illustrates a shift in the units. The front three are now at a different level than the back four. The diagram between the two sketches illustrates this shift. It occurs because the design of the place was transformed through the simple positioning of two or more objects. It is the objects relationship to each other which define the place and not the objects themselves.

The units are stacked on top of each other, sharing a space between for utilities that are being supplied from the elevator shaft. This shared floor becomes a joint. It acts as a ceiling to the unit below and floor to the unit above. The joint has been exaggerated to accommodate many functions associated with a building. Air conditioning, heating, electricity, and waste disposal reside in this area. Inside this space the utilities are protected from weathering. These utility necessities describe the joint as having a thickness.

Architecturally what determines the height of this shared floor? The height of the shared floor is determined by two conditions, the structural beams spanning between the two buildings (the frame) and the necessary clearance for utility elements. The shared floor is both bounded and constructed by the beams and their placement in the site.

A gap separates the units from the elevator shaft. It allows light to filter through the site to the ground level, connecting sky and earth. This light also finds its way into the bathroom.



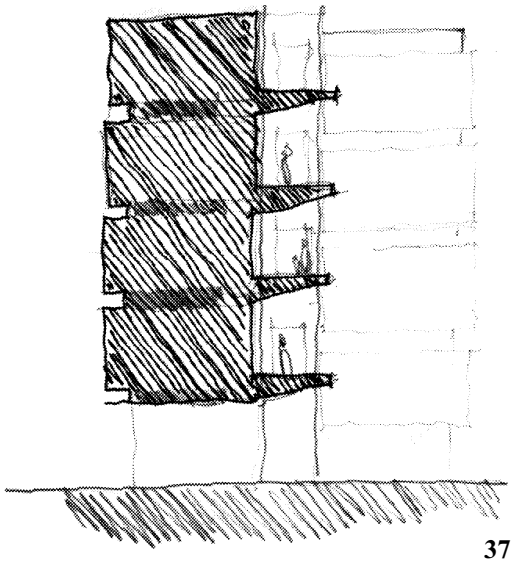


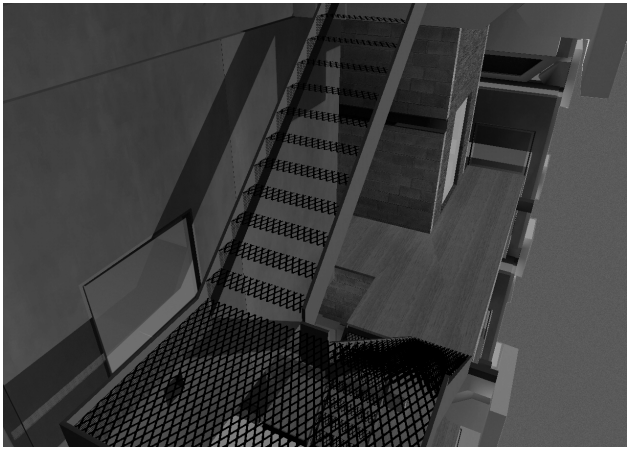
The shared floor is connected to the elevator by a catwalk. The catwalk transports utilities as well as the occupant to the unit. The space within the catwalk is enclosed, like the shared floor, to protect and conceal the pipes and other services that bridge between the elevator and the unit.

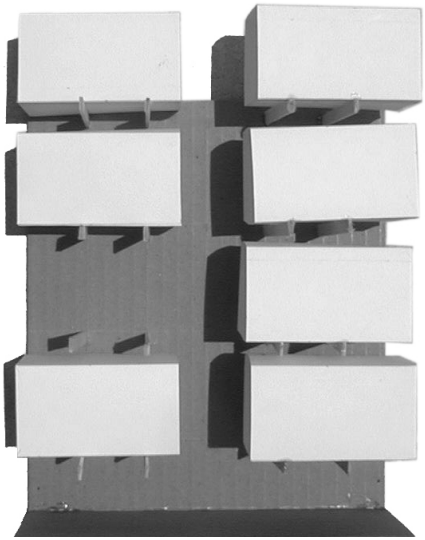
The promenade from the elevator to the front door of the unit is a unique architectural condition. It is at this place, the catwalk, that the volume of space is most dynamic. The stairs as well as the elevator open onto this catwalk occurring in front of every unit. The catwalk offers views around the elevator, to other catwalks, down to the ground, and up to the sky. The catwalk is the outdoor room of each unit.

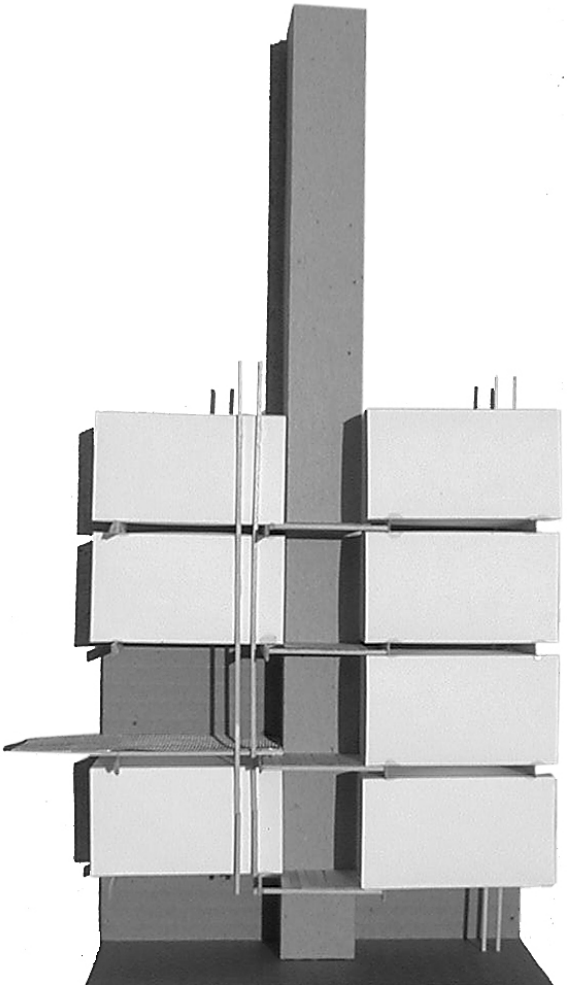
The units are positioned around the elevator shaft, which is not a structural support for the units, but an organizational pin. This elevator shaft is located in the geometric center of the project, and is a joint at the macro level of the project. This articulated vertical joint provides transportation for the tenants and connects to the cities utilities. This connection between the city and the unit defines the elevator shaft as a joint.

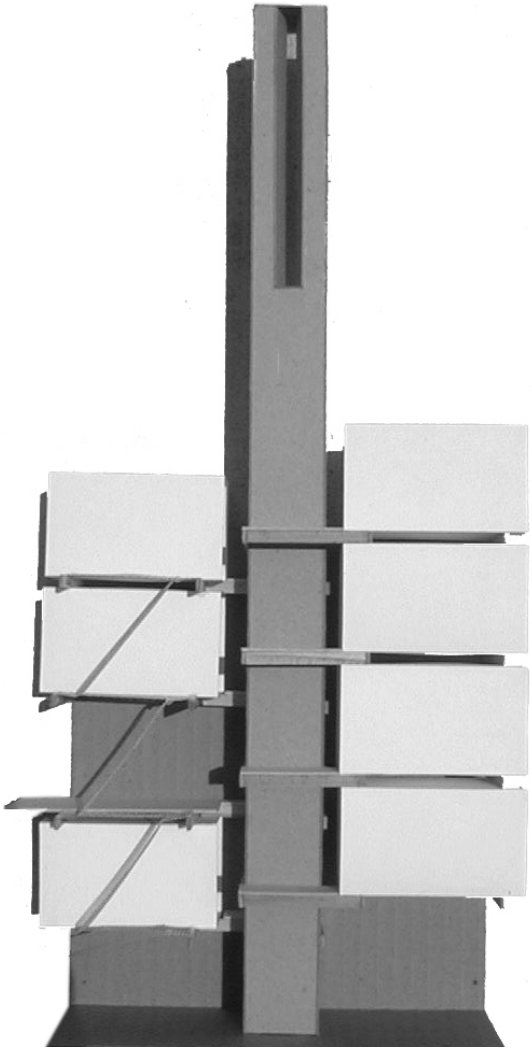
In addition to utility and pedestrian transportation the elevator shaft provides natural ventilation for the units. The extended tower creates a presence on the site and has an opening for extracting polluted air from the units. This architecture of passive ventilation gives the elevator tower its form.

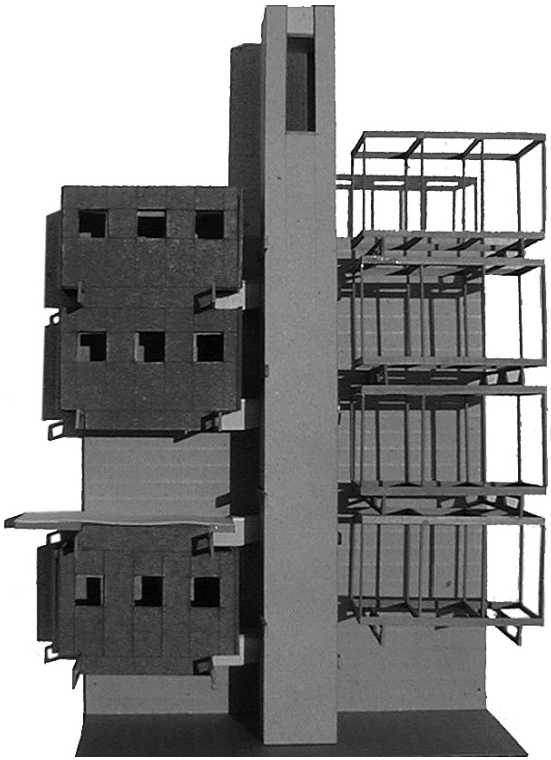




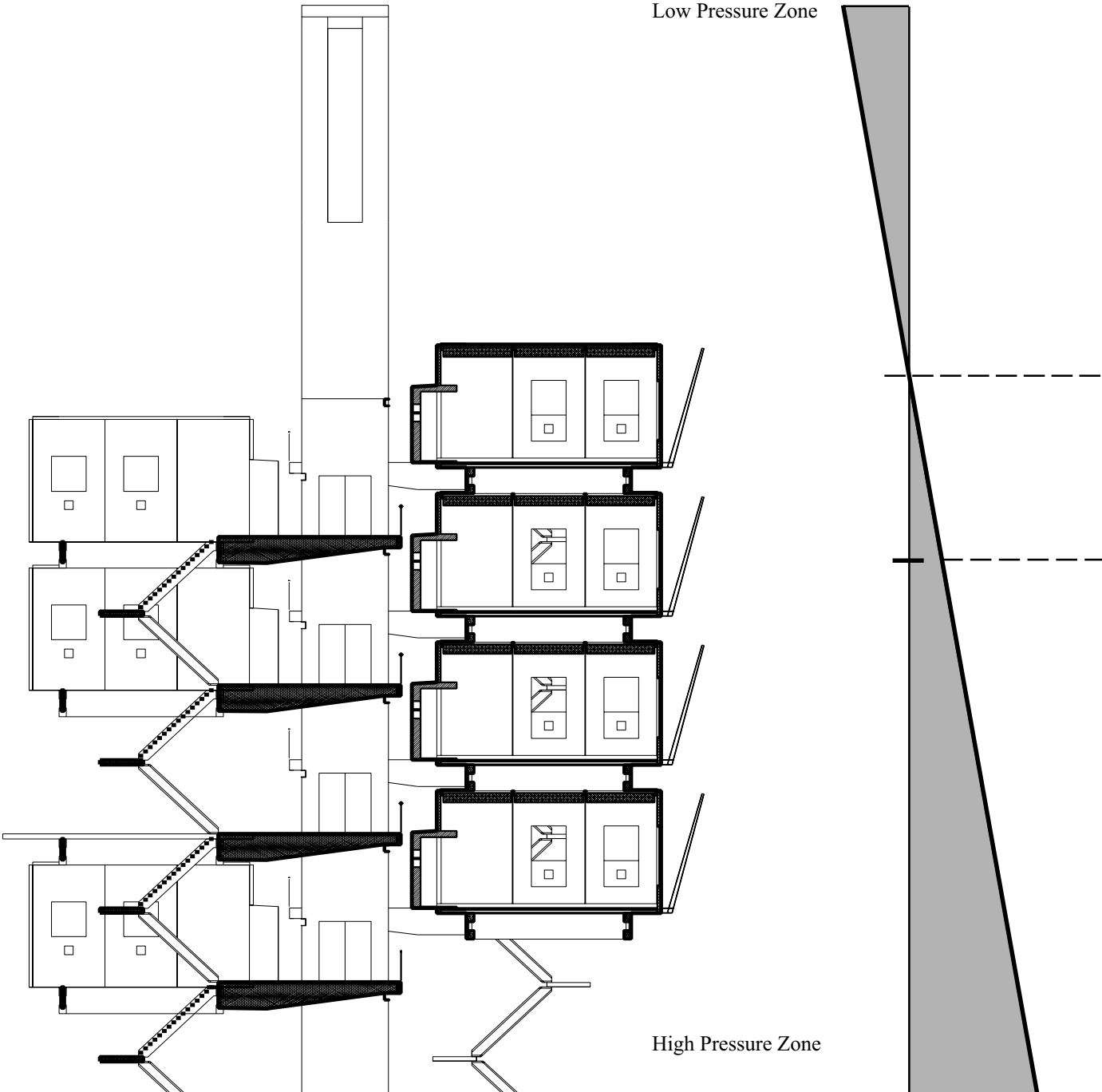








Passive Ventilation


Low Pressure Zone
High Pressure Zone

New Neutral Zone

Neutral Zone by Default

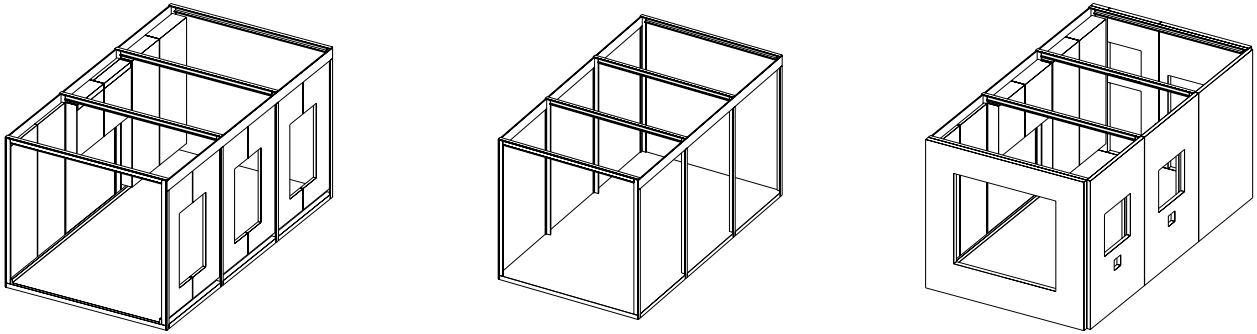
At the top of the tower there are four openings through which air passes and is accelerated due to the venturi effect. The accelerated air creates a low air pressure zone at the top of the tower. The air under high pressure in the units will pass through the elevator and out the top, removing contaminated air from the units.

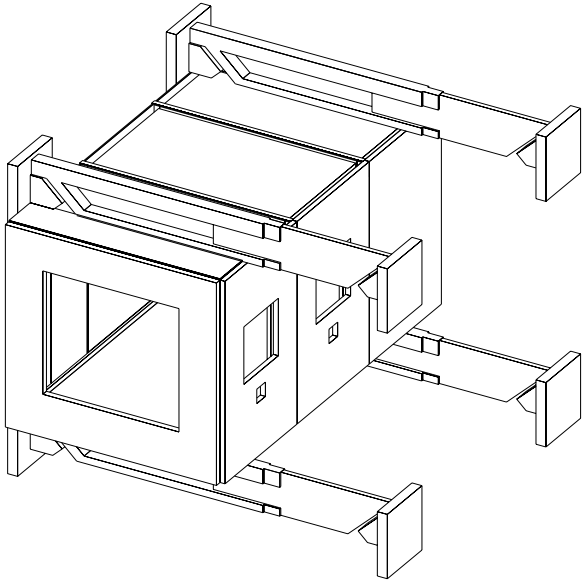
The openings in the tower were designed to be omnidirectional. This allows a breeze from any direction to start the ventilation of the unit. The amount of breeze will affect the amount of air that is extracted from the units. The direct connection between air speed and the speed at which air is extracted from the unit encouraged the architect to find a second means for starting the ventilation. If there was no breeze, there would be no ventilation.

The final design is a masonry tower with a thin metal cladding on the top. The mass of the masonry will keep the air in the lower portion of the tower cool. Contrasting the massive masonry panels are the thin panels on the top that absorb heat during the day. This absorbed heat will create a large temperature difference inside the elevator tower. When there is no breeze, the air in the tower will rise because of the stack effect. The stack effect is the movement of air, usually vertically, because of the difference in air temperature. In this thesis project, hot air rises out of the elevator shaft while fresh air is drawn in through the units.

The diagram on the facing page illustrates the moment where air neither enters nor exits the unit. The tall elevator shaft with its articulated top raises the neutral point so that all units remain in the high pressure zone. The tower as a piece of architecture benefits from the height, functionally and as a landmark.

The Unit





What is the architecture of the unit? How is each unit open to modification? How does each unit respond to its location within the site? These questions are the major design motives for the unit. A particular unit was designed and then repeated to create the complex. These five points are the basis for the architecture of each unit. Stemming from these points is the idea of prefabrication and the articulation of the assembly.

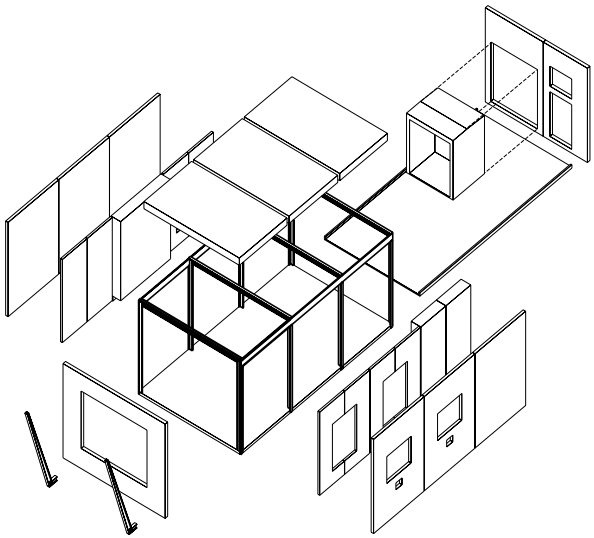
Each unit is to be perceived as one space.

The roof, walls, and floor are structurally independent from each other.

This is not a house.

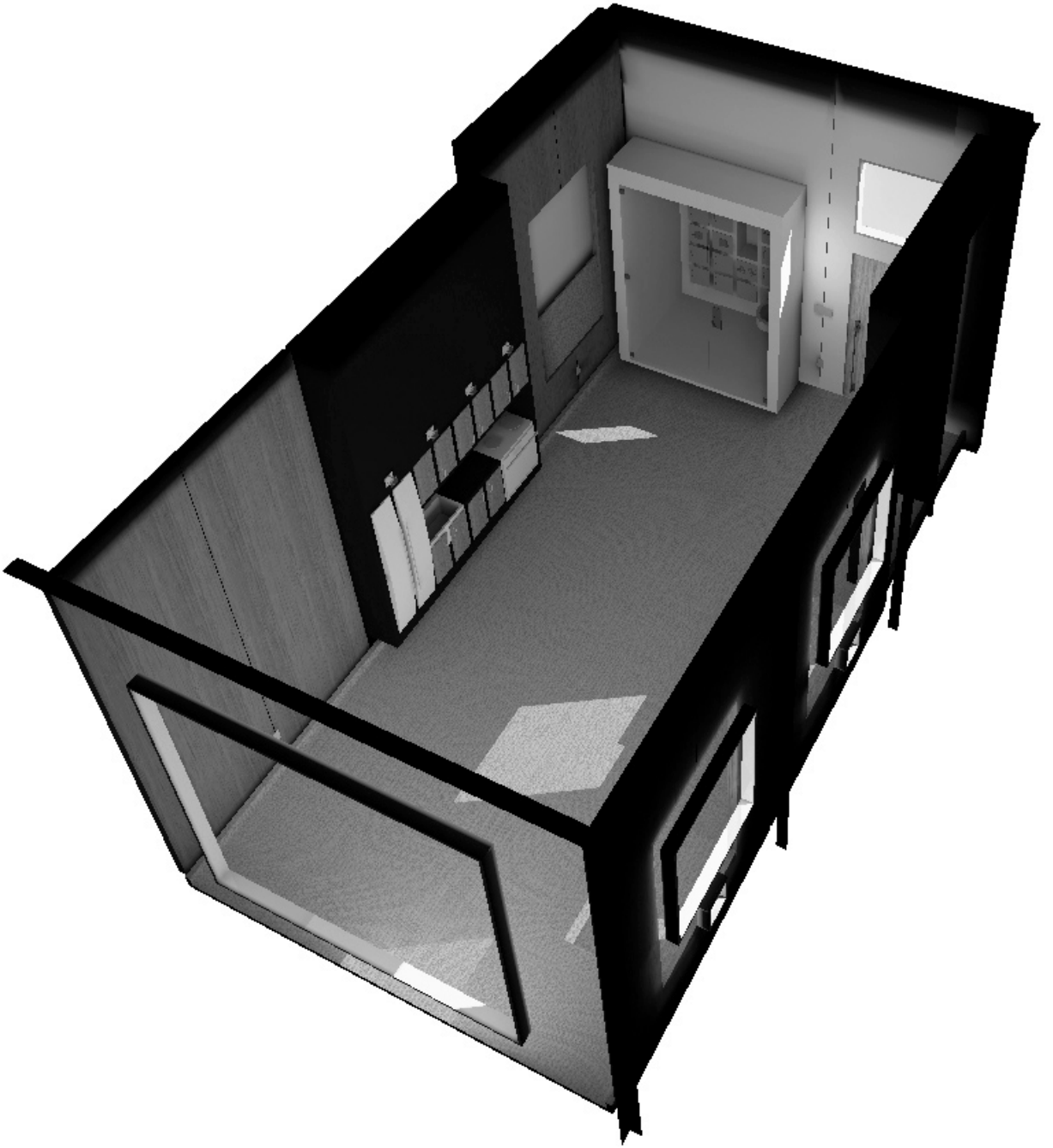
There is a place in the site for this community to gather.

From the street each unit is perceived as corresponding to a single individual.



Seven units have been set into the site. Their dimensions are comparable to the standards in the mobile home industry. This is so because the original intent of this thesis was to transport the units to the site as a 'complete' unit. This method of construction was subsequently transformed into a assembly of elements. The final measurements of the units reflects the original method of construction.

The units are no more than rectangular volumes which are stacked within the site in two vertical columns. The units are pressed up against the existing building using the edge of the site as the sixth exterior side of a rectangular solid. The units purposely do not occupy the entire site. This careful juxtaposition of units creates a place for them and their occupants.



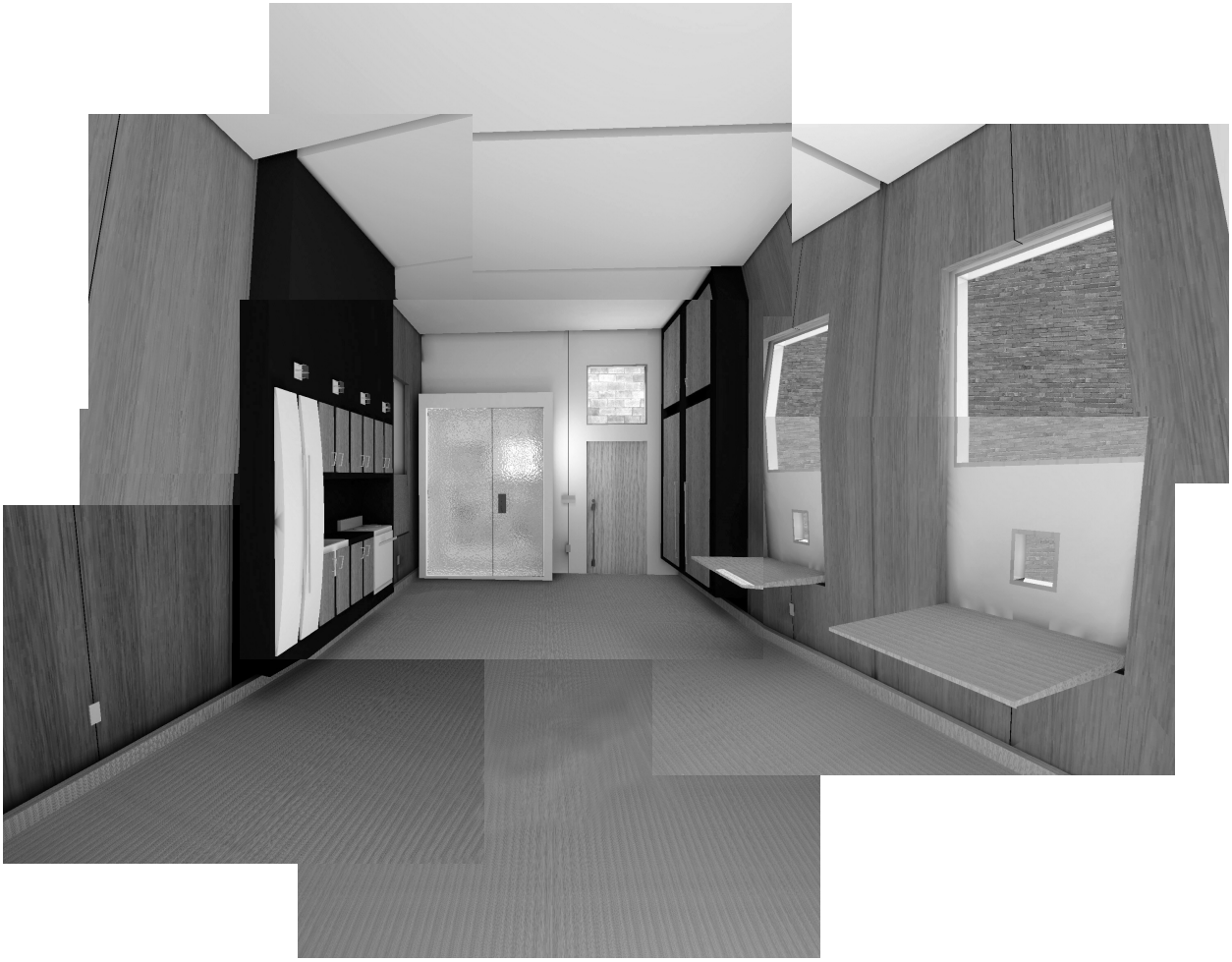
The unit has been designed as a prototype for many different site conditions. This is possible because each unit is placed into a frame which responds to each site.

Each unit has a chassis-like structure to which all prefabricated elements are attached. This structure is the mediator between all elements. It connects all the entities and transfers the load through the building to the beams. The chassis is not visible from the inside or the outside.

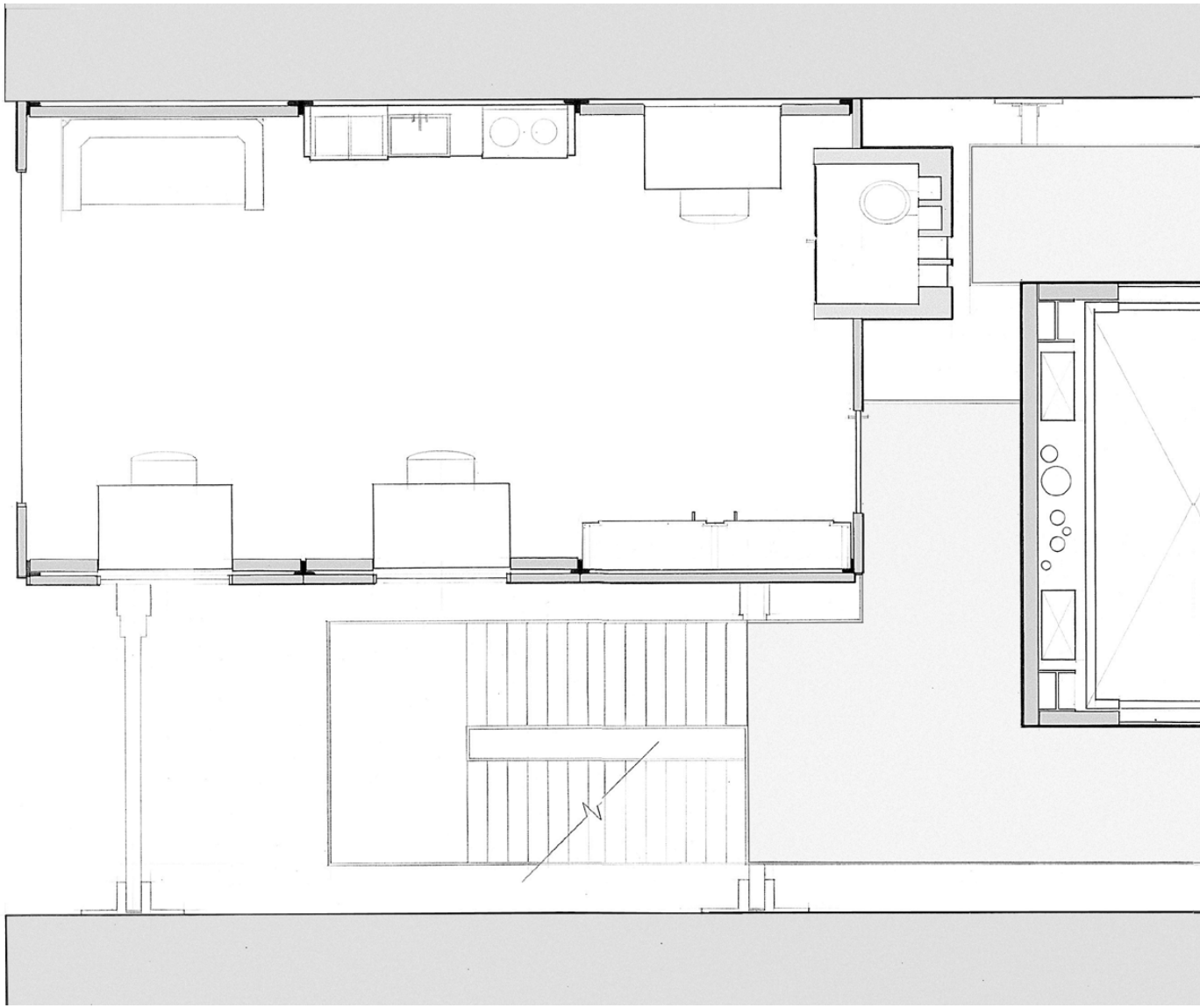
Its presence is evident through the assembly of elements. A separation in the interior panels of one inch is located at each vertical element of the chassis. From the exterior, panels are fastened to the chassis, naturally aligning all vertical joints with the structural elements. The ceiling panels also have a reveal at each horizontal chassis element. These articulations are not present simply because of the chassis, but because of the need for articulation of the joint between panel and structure. This chassis makes the separation of responsibilities of each element possible.

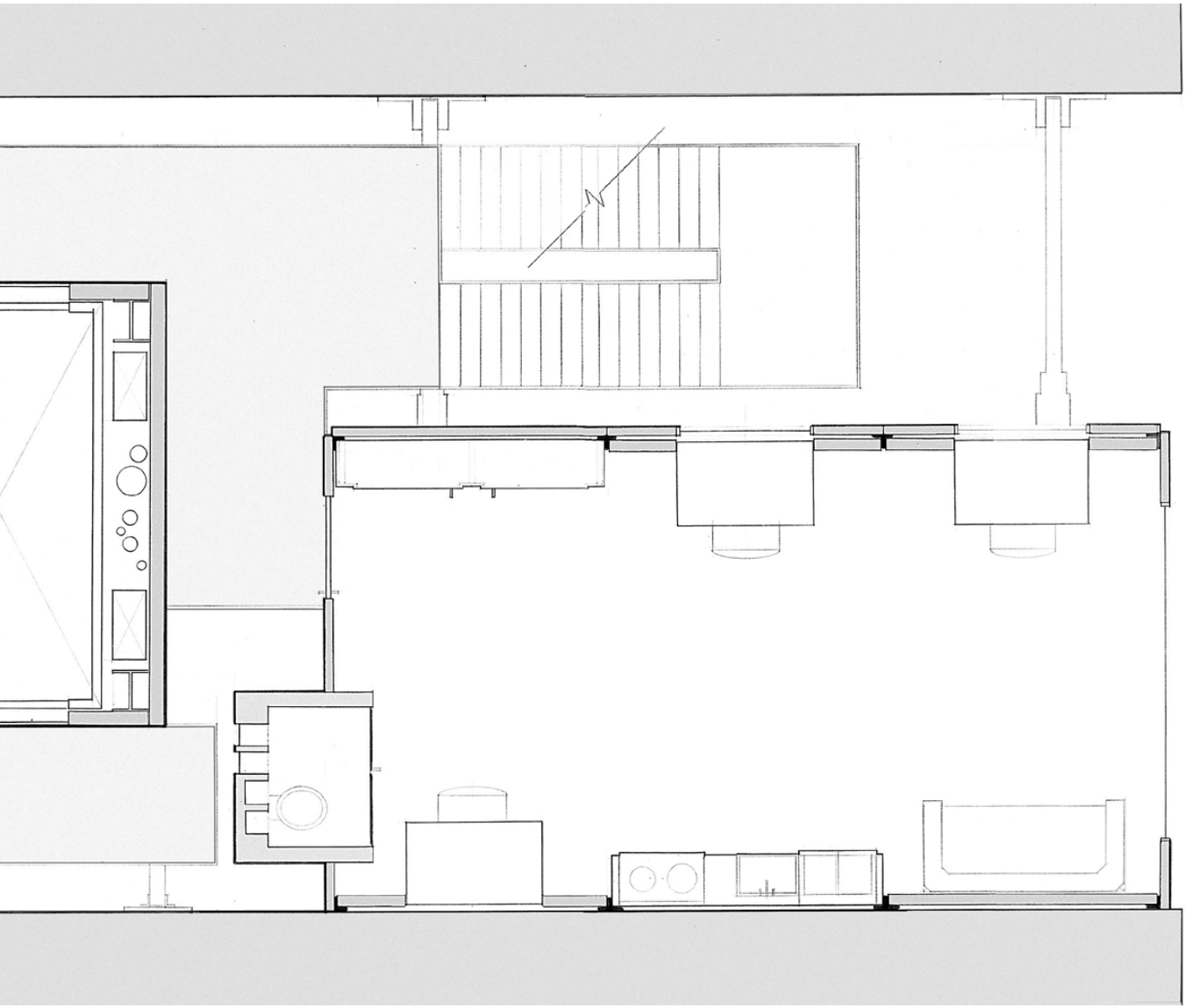
The room of the unit is a single space. It was not the architect's desire to have partition walls defining smaller rooms inside the unit. The functions of the building have been moved to the perimeter. Room identities have been associated with wall panels. The space is singular, but the single space contains eight rooms with eight functions. A clarity in the design of and assembly of elements makes the room read as a single coherent entity.

The bathroom contradicts the architect's statement of this unit being one space. The bath is slid into a panel, it is not a panel in itself. The volume of the bath is divided from the volume of the unit. The bath cantilevers out of the unit, occupying a portion of the elevator shaft. The cantilevered bath takes up less space in the unit, allowing the interior space of the unit to be a single space.

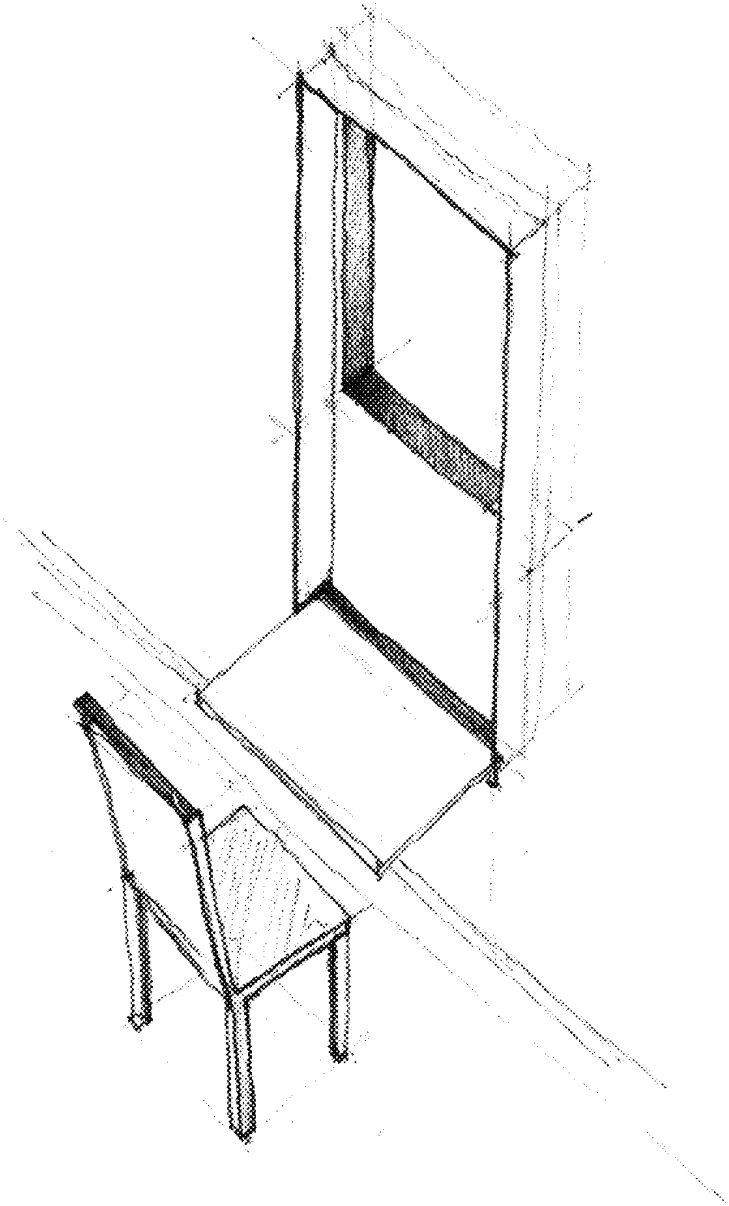


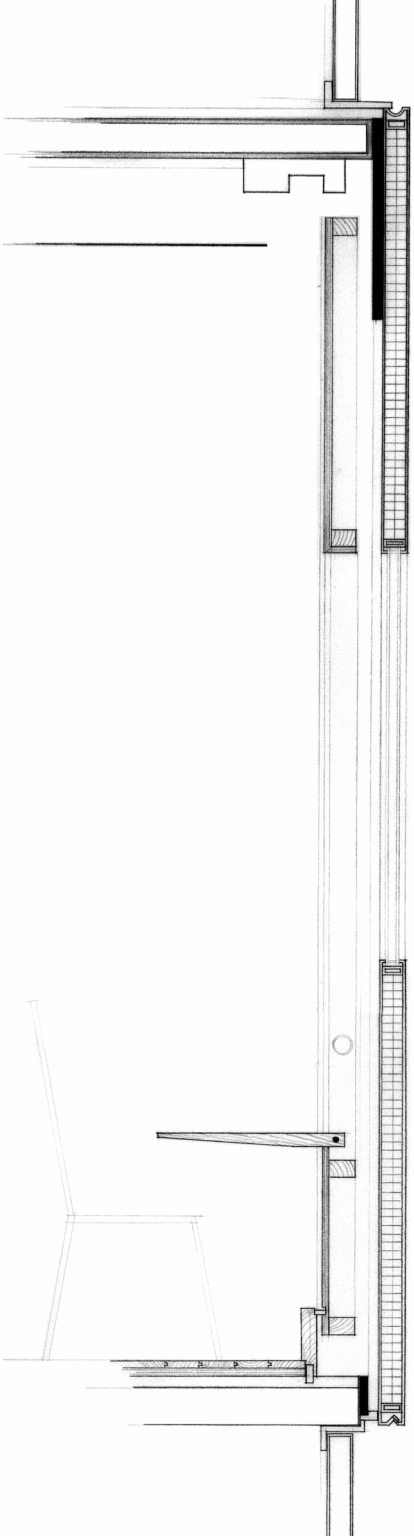
The configuration of this unit is site specific. In this configuration is the resolution of architectural desires for view, circulation, function, and integration of utilities. This configuration would not necessarily be appropriate for all sites, but the possibility of reassembling the elements in a new configuration in a new site is the strength of the thesis.





The Panel





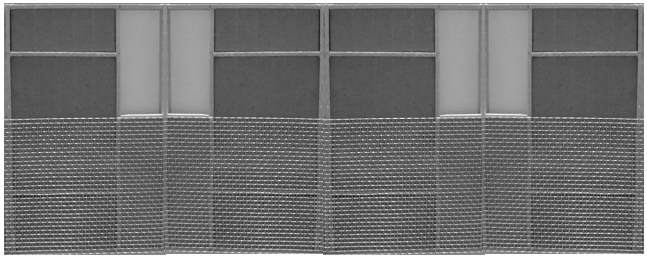
How does an architect articulate a wall? Each wall of the unit is divided into three panels. These panels differ in function but remain in the module of the steel frame. They may be fasten to the chassis in many different configurations.

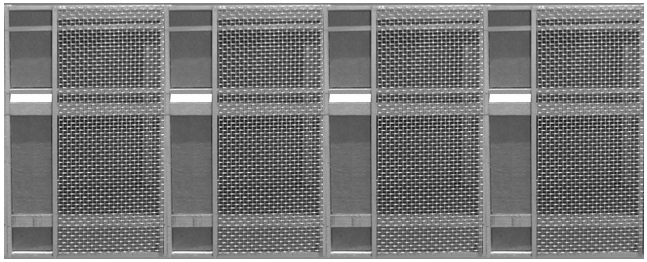
Upon entry one encounters a closet panel. This panel of storage spans from floor to ceiling maximizing the storage area. The second panel accommodates a kitchen which also spans from floor to ceiling. The appliances are within the panel and are not standard products, but function as a standard kitchen, containing a stove, sink, refrigerator, and counter space. The kitchen also consumes one module of the eight foot frame. The third panel is a desk panel, which functions as both a window and a surface. The folding surface can be used for a variety of activities. It can change the character of the space by folding into the "up" position, streamlining the space for the occupant. It can fold down, providing a horizontal surface. The quality of light is also different within these two positions. A window is only revealed to the occupant when the panel is folded down.

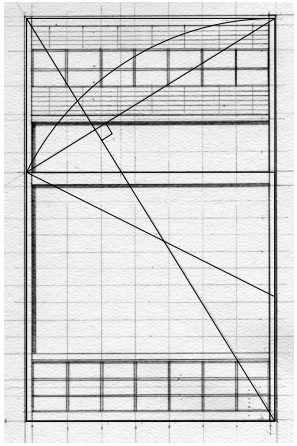
The bathroom is different from the other panels. It is a prefabricated fiberglass room that is slid into an opening in the exterior panel. This panel is the most unique condition because the bathroom requires a greater privacy than any other room.

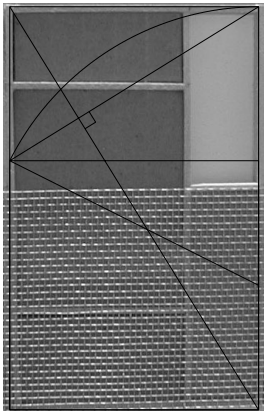
There are two other special panels in this system. One is the end panel, which has a large window. The other is the panel that contains the front door. These panels are of a width and height that does not allow them to be exchanged with any other panel in the system.

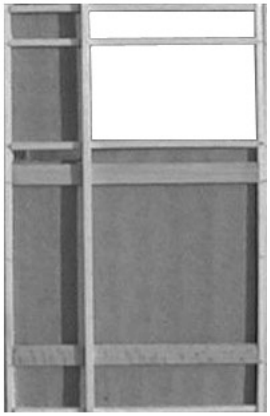
The material of the interior panel is a dark stained plywood. Wood is used on the inside because of its tactile quality. The folding desks are constructed of oak for the same reason. The tactile quality of wood is more gentle to the touch than most materials. The wood interior contrasts the metal exterior.

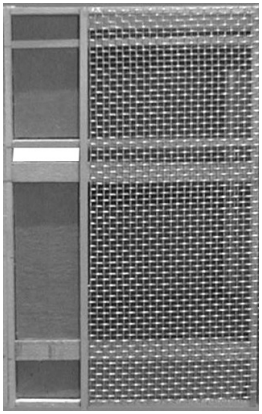




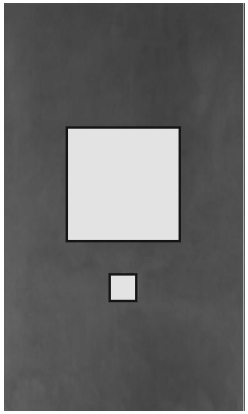


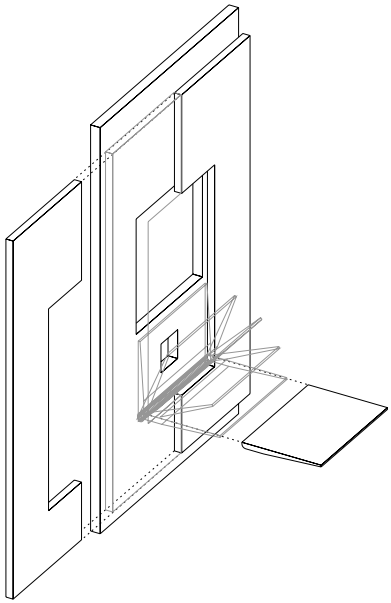


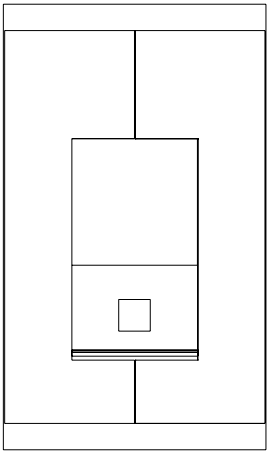


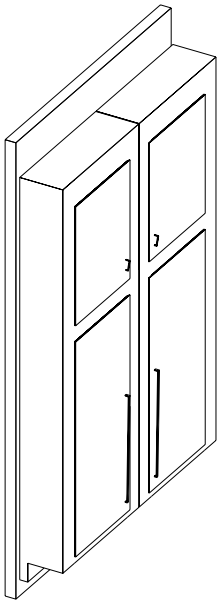


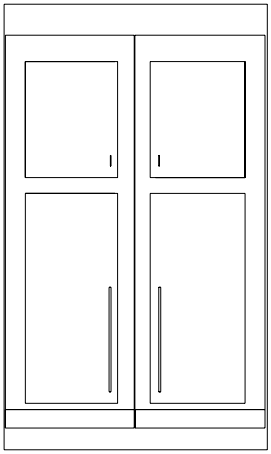
The exterior panels are a thin steel membrane stretched over a steel frame. This cold material is appropriate for the exterior because of its ability to be machined into precise dimensions. This machined quality on the exterior gives a coherency to the many units.

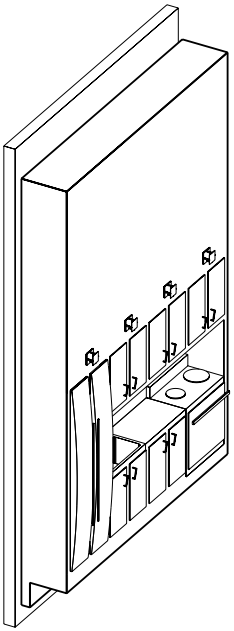


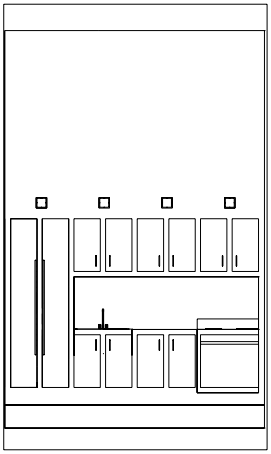


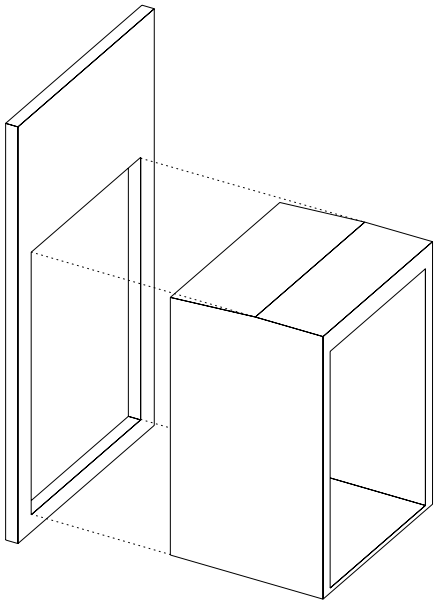


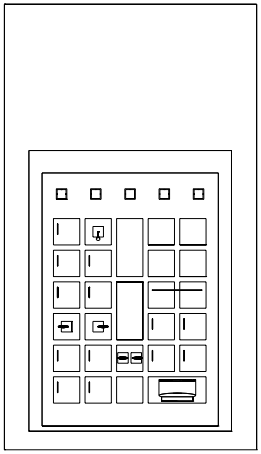












Life in the Unit.

Conclusion

The thesis started with the investigation of modular homes. The final design is far from this beginning, but produced more than the architect could have imagined. The modular home is now an assembly of elements. This method of construction led to the discovery that the architecture of the design starts with the method of construction. Another discovery was the change from a 'complete' unit to an assembly of elements. Also discovered was a joint that exists inside every wall. These architectural thoughts have the greatest presence in the thesis and shape the project and the document. The engagement in the understanding that this unit has real functions encouraged the architecture. Utility functions were incorporated in the design from the beginning, preventing the architecture from compromising with necessity. The unit designed is not a final solution but the most current moment in the continual design process.

Live the Unit

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